



A Nuffield Farming Scholarships Trust Report

Award sponsored by

The Yorkshire Agricultural Society



**Investigating different farming systems
to improve efficiency
in the UK beef industry**

Richard Pennock

July 2015

NUFFIELD UK

NUFFIELD FARMING SCHOLARSHIPS TRUST (UK)

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A Nuffield (UK) Farming Scholarships Trust Report



Date of report: July 2015

*"Leading positive change in agriculture.
Inspiring passion and potential in people."*

Title	Investigating different farming systems to improve efficiency in the UK beef industry
Scholar	Richard Pennock
Sponsor	The Yorkshire Agricultural Society
Objectives of Study Tour	To investigate different farming systems in order to improve efficiency and increase profitability in UK beef production
Countries Visited	UK Australia USA Canada Brazil Uruguay
Messages	<p>In order to improve efficiency and increase profitability, the UK beef industry should consider:</p> <ul style="list-style-type: none">• Introducing a grading system which rewards high eating quality• Dispensing with an extended store period and finishing cattle at lighter weights• Improving supply chain integration• Focusing breeding strategies towards profit-linked traits

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DISCLAIMER

The opinions expressed in this report are my own and not necessarily those of the Nuffield Farming Scholarships Trust, or of my sponsor, or of any other sponsoring body.

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Nuffield Farming Scholars are available to speak to NFU Branches, Agricultural Discussion Groups and similar organisations

*Published by The Nuffield Farming Scholarships Trust
Southill Farmhouse, Staple Fitzpaine, Taunton TA3 5SH
Tel : 01460 234012
email : director@nuffieldscholar.org
www.nuffieldscholar.org*



1. Personal Introduction

I am 32 years old, and grew up on a small livestock farm on the North Yorkshire coast. I graduated from Harper Adams in 2005 with an HND in Agriculture and Mechanisation, and then trained and worked as an agronomist for several years before taking up my current position as Farm Manager for Sir K D Morrison at Myton Hall Farms in North Yorkshire. I live on the farm with my wife Becky, a research scientist.

Myton Hall Farms is a large beef finishing unit and mixed farm, supplying beef and lamb to Morrisons' supermarkets. We house 1000 finishing cattle all year round and run a flock of 300 commercial breeding ewes. We also farm 1100 acres of land including combinable crops, maize silage and grassland. At Myton Hall Farms we utilise recording systems to record productions costs for cattle on an individual basis and we are always looking for ways to increase productivity and improve margins.



Figure 1: The author, Richard Pennock, with some of the beef cattle at Myton Hall Farms



2. Background to study subject

In the current economic climate, the beef industry in the UK faces constant pressures to maintain positive margins. 2014 was a particularly challenging year for UK beef farmers and highlighted the weaknesses of an industry so dependent on the markets for store and fat cattle. I believe that going forward the UK beef industry must adapt, moving towards better management systems in order to make beef pay in challenging markets. It was this desire to drive change within our own business and the industry as a whole, which inspired me to apply for a Nuffield Farming Scholarship. I hope that the knowledge gained during my study tour could help to establish a better, more robust beef industry within the UK.

3. Countries visited on my study tour

My aim was to visit some of the world's biggest beef producers, countries which were operating systems different to those in the UK industry, but which had elements within their systems which could potentially be adapted for use in the UK:

Australia (March 2014)

Australia has a large cattle industry, with a thriving export market to Japan and China, countries world-renowned for demanding high quality meat products. I was interested to see how the Australian beef industry was fulfilling this demand for quality, and if lessons could be learned to improve quality and consistency within the UK industry.

USA and Canada (June – July 2014)

The USA is a world leader in beef production. It is known for extremely large scale feed-lot style beef production and for the high quality and eating experience of its beef. I was hoping to learn more about large scale beef farming and the infrastructure required to support such enterprises. The USA is known as a world leader in research and development. Interest within our own UK beef industry in the use of new technologies is limited, so I was keen to see how the USA were utilising technology to improve their beef industry.

Brazil (December 2014)

Brazil is one the world's largest beef producers and a significant exporter of beef products. It is also a country with a very limited infrastructure compared to most of the other countries I visited. I was interested to learn about the challenges such a lack of infrastructure presents, and how the Brazilian beef industry manages these challenges to maintain a large and profitable industry.

Uruguay (December 2014)

Uruguay has a very similar climate to that of the UK and operates, almost exclusively, a grass-fed beef industry. I was interested to see how beef production is managed in a purely grass-fed system.



4. The UK beef industry: current challenges

4.1. Introduction

The UK beef industry is currently facing some of its greatest challenges of recent years. The industry is in trouble following years of poor profitability. In the current challenging economic climate, British beef is struggling to establish a competitive position in the global market place, and continues to lose ground in the domestic market to cheaper protein sources such as pork and poultry. High input costs and a reduced consumer demand for beef have left many producers struggling to maintain positive margins. As a beef finishing unit manager I have been forced to look closely at our own operating systems, and at the industry in general, in an attempt to reduce production costs and restore profitability in an increasingly challenging market place. A Nuffield Farming Scholarship has given me the opportunity to travel around the world, visiting some of the biggest beef producing nations, in search of systems or ideas which could promote a profitable, robust, sustainable UK beef industry as a basis for future development and growth of the sector.

4.2. The influence of historic subsidies on beef industry structure

The UK beef sector is characterised by many small beef herds, with few large-scale businesses in operation. The abundance of small farms is a direct result of historic subsidies paid prior to CAP reform. Direct production-linked subsidies such as the Beef Special Premium Scheme (BSPS) meant that farmers were paid on a per-head basis prior to 2005. Production-linked subsidies supported a partial recovery of suckler herd numbers in the wake of the BSE crisis in the late 1990s, and allowed many small, inefficient businesses to remain in operation. Following de-coupling (the end of production-linked subsidies) due to CAP reform, the BSPS and other similar schemes were superseded by the Single Farm Payment Scheme (SFP) in 2005. The introduction of the SFP, and subsidies based on acreage rather than headage, prompted a decline in suckler cattle numbers, as some producers could not maintain positive margins in the absence of production-linked subsidies.

4.3. High production costs associated with beef production in the UK

Inefficiency in beef production is a major challenge for the industry. Beef production in the UK has high production costs. The majority of UK beef cattle are housed during the winter months and grazed outdoors during the summer months. This is mainly due to the UK climate, and an inability to graze cattle outside during wet winters, particularly with the high numbers of cattle per acre typically stocked in the UK. These high numbers are driven by both high land value and by limited availability of land in a small island nation. Alongside high store cattle prices, management costs associated with housed cattle are high. Labour, machinery, infrastructure, feed and bedding all make the production cost of beef high in the UK, particularly when compared to other countries whose climate and/or land availability allow out-wintering of cattle, thus significantly reducing input costs.

It is these inherently high production costs which means the UK is unable to compete with countries such as the USA in the global export market. The USA is rich in resources including land space, which makes the out-wintering of cattle possible, even in areas with a similar climate to the UK's. When

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sufficient space is available, low input systems producing high numbers of cattle are perfectly feasible, and give the USA a strong position in the global export market. The routine use of hormones to increase productivity in the US beef industry also helps it maintain a competitive position in the beef producing nations of the world. The use of hormones is prohibited in the UK beef industry, which also adds to increased production costs in the UK compared to countries using hormones, due to longer finishing times. However, the ban on hormone use does act as a powerful differential for the UK beef industry, preventing any large scale imports from countries such as the USA, with whom we are currently unable to compete with on price.

4.4. Factors driving a reduction in beef sales

In times of economic challenge, a robust demand for beef is required to offset high production costs. However the UK is currently experiencing a downward trend in the demand for beef. Average beef consumption per capita per year in 2013 was down 1.2kg from the year 2000 whilst, in the same period, consumption of pig meat per capita rose 0.5kg and consumption of poultry rose 1.2kg (1)*¹. According to sales records, national beef sales fell from 1,169,000 tonnes in 2010 to 1,104,000 tonnes in 2013 (1)*. A number of factors are likely to contribute to the reduction in beef sales, including financial pressures, health concerns, changing lifestyles, low consumer confidence and environmental considerations.

4.4.1. Value for money and alternative protein sources

For consumers affected by the economic downturn, value for money has become increasingly important. High production costs mean that beef is an expensive product. The beef price/kg is around £4/kg for cheaper cuts such as mince, or £8/kg for stewing steak, rising to £10/kg for roasting joints and around £30/kg for the most expensive cuts such as fillet steak. By comparison, other forms of protein, such as poultry and pork are cheaper. With pork and poultry prices ranging from £3 -£9/kg, these products must appear to offer better value for money to consumers in difficult financial conditions (2)*. Records support this, with pork and poultry sales increasing in the same period that beef sales have declined (*Figure 2 overleaf*).

It is the lower production costs in both the pork and poultry industries that mean retail prices of these meats remain lower than beef. Initial outlay costs for animals are much lower in both industries, and much higher numbers of pigs or chickens can be produced on the same area of ground compared to cattle. The feed conversion rate is also much higher in pigs and chickens than it is in cattle. Poultry can achieve 1kg of live weight gain from around 1.8kg of dry matter (3)*, compared to 1kg live weight gain in pigs from approximately 2.65kg dry matter (4)*, whilst cattle require between 8 -10kg dry matter for 1kg live weight gain, meaning feed costs are much lower in both the pig and poultry industries compared to the beef sector. Furthermore, the numbers of offspring produced each year from a single female is high in both these industries, whilst the beef industry can only produce one calf per year per cow. As continued high production costs drive high on-shelf prices, the beef industry is continuing to lose sales to both the pork and poultry industries.

¹ *For all reference figures quoted in brackets please refer to Chapter 14, on page 44 to check the source
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Meat	2010	2013
Beef	1169	1104
Poultry	1911	1986
Pork	1513	1536

Figure 2: Total UK meat sales (x 1000 tonnes) in 2010 compared to 2013.

Data from EBLEX UK Cattle Yearbook 2014 (1)*.²

4.4.2. Changing lifestyles and dietary habits

As beef retail prices increase, it is interesting to note that mince now accounts for approximately 38% of fresh beef sales (1)*. This trend probably reflects a demand both for affordable meat, and also for meats which can be used in meals which are quick and simple to prepare. Other factors alongside economic considerations may also be contributing to the decline in beef sales. Our lifestyles and the way we eat have changed in recent years. In a 2013 YouGov survey, along with saving money, other reasons given for reduced meat consumption included concerns for animal welfare, concern for quality and safety, provenance, environmental considerations and health reasons (5)*. High level consumption of red meat has been linked to an increased risk of diseases including heart disease and colorectal cancer (6)*. This has been highlighted in the national and international press and resulted in initiatives aimed at reducing red meat consumption, promoted by the perceived benefits to human health.

4.4.3. The environmental impact of beef farming

In addition to lifestyle and dietary changes, enhanced environmental awareness could be contributing to reduction of beef sales. Beef and dairy farming are considered to be significant contributors to climate change through the production of greenhouse gases. There is a growing demand for meat in countries such as China, and as the livestock industry expands to meet this demand, so will agricultural emissions. Within the UK industry, there is no legislation linked to greenhouse gas emissions and, whilst there is no worldwide plan in place to reduce agricultural emissions, various groups have commissioned studies and reports to examine the effects of agriculture on global emissions. A 2014 report by the United Nation's Intergovernmental Panel on Climate Change (IPCC) suggested that dietary change and reduction of meat consumption could 'substantially lower' emissions (7)*. Based upon reports of this type, environmental groups have come up with initiatives such as World Meat Free Day (8)* which ask participants to pledge to eat a meat-free diet for one day, in an effort to demonstrate the benefits of reducing agricultural emissions.

4.4.4. Consumer confidence and the horsemeat scandal

The UK beef industry has some of the best traceability regulations in the world, which should provide consumers with a high level of confidence in the provenance of British beef. However, the horsemeat scandal has undoubtedly damaged this confidence, and has likely had a negative impact

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on beef sales since it emerged in 2013. The announcement by Irish food inspectors in mid-January 2013, that they had found traces of horsemeat in beef products sold by a number of British supermarket chains, brought the UK beef industry supply chain under the scrutiny of both the Food Standards Agency (FSA) and the British public. Further testing identified a number of beef ready-meal products containing horsemeat (up to 100% in some cases) and also beef products contaminated with traces of pork DNA. These ready-meals were produced and sold by some of the food industry giants, including Britain's largest retailer Tesco, high-end retailer Waitrose, and the biggest food producer (Nestle) and caterer (Compass) in the world.

The horsemeat scandal highlighted a concerning lack of supply chain control amongst British supermarkets, as products were being purchased from third parties with little or no scrutiny of their contents by the retailers. Indeed only one British supermarket was able to steer mostly clear of the scandal. Wm Morrisons is the only British supermarket to operate an integrated supply chain, owning its own abattoirs and processing plants, and sourcing direct from farms. By pursuing a strategy to control its own supply process, Morrisons alone was able to guarantee the provenance of the beef products on its shelves, whilst other supermarkets were left appearing negligent in their efforts to guarantee the source of their products (9)*. Despite the strong position of Morrisons in the wake of the horsemeat scandal, the widespread sale of contaminated beef products across British retailers left consumers angry. At a time when beef retail prices were so high, loss of consumer confidence had significant implications on the public perception of supermarket meat and probably contributed to the observed decline in beef sales during this period.

Wm Morrisons is the only British supermarket to operate an integrated supply chain, owning its own abattoirs and processing plants, and sourcing direct from farms.

4.5. A financial crisis for British beef

Falling beef sales drove the British beef industry to the brink of financial crisis in 2014. Record global harvests resulted in a cereals price crash, meaning a significant reduction in feed costs for grain-fed beef finishing systems. This lowered production costs for finishing cattle, resulting in high demand for store cattle across the UK, as UK finishers took advantage of reduced feed costs to increase the numbers of cattle they finished.

In sharp contrast to the store price, fat prices, driven by a combination of high availability of fat cattle and low consumer demand for beef, fell every week for 26 weeks.

The majority of beef finishers in the UK look to purchase a similar type of animal to finish. Typically these animals are of continental breeding, and are sourced from the suckler herd. As the suckler herd declines, so does availability of these types of animals, and in recent years demand for such cattle has seen store prices increase. In early 2014, as grain prices crashed and finishers looked to increase their cattle numbers, the price of store cattle



was approximately 230p/kg throughout the first 6 months of 2014. In sharp contrast to the store price, fat prices, driven by a combination of high availability of fat cattle and low consumer demand for beef, fell every week for 26 weeks. While store cattle prices remained high, fat prices reached a low of 328p/kg in July 2014 (10)*. The combination of significantly increased outgoings and significantly reduced returns left many beef farmers in the UK operating at negative margins by the middle of 2014. Some recovery in the fat price in late 2014 eased the financial pressure on many beef farmers, but the financial crisis of 2014 highlighted the vulnerability of the UK beef industry to fluctuations in input prices and returns. As price fluctuations and financial pressures look set to continue, the industry itself must take measures to crisis-proof the UK beef sector and make it better able to cope with external financial variations.

As price fluctuations and financial pressures look set to continue, the industry itself must take measures to crisis-proof the UK beef sector and make it better able to cope with external financial variations.

In my opinion, the UK beef industry will need to undergo significant change and modernisation in order to do this. In particular I believe that reform in a number of key areas will be required. These include the supply chain, UK beef finishing practices, beef cattle breeding and genetics, and the EUROP grading system.

It was this belief that inspired the subject of my Nuffield Farming Scholarship, as I sought ideas from beef industries around the world, which could help develop a profitable, sustainable UK beef industry as a basis for strong future growth.



5. The beef supply chain

5.1. Introduction

The current UK beef industry is made up of a large number of small farmers, with little or no integration between businesses. The average UK beef herd size in 2012 was 31, across 60,246 separate holdings (1)³*. There is wide variation in the breeding/type of cattle being fattened, in the systems operated, and in the subsequent quality of the beef being produced. The UK beef industry produces beef mainly for the domestic market, with little focus on exports. A 2012 EBLEX report showed that, in 2011, beef consumption exceeded production, so that the UK was increasingly reliant on the import market (11)*. This, combined with an inability to compete on price with producers from some of the largest beef producing nations in a competitive global exports market, means that there is a limited export trade open to the UK beef industry.

Within the domestic market, the route to consumer is also fragmented, with numerous independent processors supplying retailers, and a distinct lack of integration in the supply chain. In this chapter I will examine the structure of the UK beef industry in detail and also describe the structures of different beef industries from around the world, where integrated supply chains are being utilised to cut production costs and improve quality.

5.2. How lack of integration affects the UK beef supply chain

There is a distinct lack of integration amongst the various components in the UK beef sector. The many small farms which breed, store and fatten cattle operate on the whole as autonomous concerns, each with their own protocols and aims for their own sector of the beef supply chain. There is little if any feedback between the different members of the supply chain, despite the fact that everyone working within it should have a shared common aim – the production of a high quality end product, and profitability for all members of the chain.

The absence of any type of useful feedback is a characteristic of all levels of the UK beef supply chain. The prevalence of auction marts and the tendency to sell cattle at auction means that there is often no contact, let alone feedback between beef cattle breeders and finishers. Breeding has a direct influence on traits like net feed efficiency and time to finish, which are major factors in the efficiency and profitability of a beef finishing system. The breeding of beef cattle is discussed in detail in Chapter 6. There is currently little feedback on finishing performance to cattle breeders, but better communication here would allow the performance in the finishing units to influence breeding decisions, improving efficiency and profitability for the finishers, and guaranteeing a strong demand for calves which were bred for finishing performance.

If this feedback was extended further up the supply chain, it could also rectify one of the major difficulties for beef processors in the UK industry - carcass size variability

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If this feedback was extended further up the supply chain, it could also rectify one of the major difficulties for beef processors in the UK industry - carcase size variability. As a major proportion of beef is packed into standard serving/portion sizes, carcase size variability causes issues in the packing plant, where standard sized trays are used for particular cuts and servings. Carcases which are much larger or smaller than 'average' will not fit the standard sized packaging, yet this kind of carcase variability is extremely common in UK beef production (12)⁴.*.

Such size variability is likely caused by a number of factors including the many different breeds of cattle which are bred and fattened in the UK, and variability across different producers in terms of target fat weight. A lack of feedback from processors means that variability continues to be an issue in the absence of a common target fat weight across all producers in the UK. Communication and cooperation between processors, finishers and breeders could go some way to reducing this problem, by the setting out of a common aim, for a more standardised carcase, fattened to desired weight.

5.3. Integrated supply chains in beef production

Without an integrated supply chain, the supply of cattle for finishing can vary in quality. Feedback of information on finishing performance can be extremely useful in influencing breeding decisions, and guaranteeing a supply of cattle which will perform well during finishing. At Decatur County Feed Yard in Kansas, USA, a valuable system of information feedback to breeders is helping in the formulation of breeding strategies targeted at breeding cattle which will perform well in the feed yard. Extensive measurements are recorded using an automated handling system (*See Figure 3 on next page*).

This system includes camera grading for animal dimensions and also weight measurements. Ultrasound scanning is used to measure back fat. These measurements are recorded and then collated into performance records. These performance records are used to influence management regimes for cattle on an individual basis, and also form the basis of owner feedback. The feed yard operates a system of full- or part-retained ownership, and this is a valuable tool in improving the quality of cattle entering the feed yard. Retained ownership ensures that breeders have a financial interest in breeding animals which finish well, which is a powerful incentive to target their breeding strategies towards such characteristics. Without retained ownership, the information collated in the feed yard is still useful, but the incentive to change breeding strategies is indirect, and reliant on a concept of increased value for calves bred for these characteristics, which may or may not be taken on board by breeders. Retained ownership systems, on the other hand, give an actual monetary benefit to breeding for improved finishing performance.

As well as retained ownership, other integration strategies have been designed to guarantee consistency and quality of animals for finishing, by utilising the breed consistency available from dairy cow breeding. In dairy industries across the world, a common breeding aim is shared across producers, with breeding targeted to produce cows with high fertility and high milk yields. Many years of highly selective breeding has resulted in a uniformity of offspring not seen amongst

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different beef suckler cow breeds. In both the Australian and USA beef industries, I met producers exploiting this uniformity to drive improved consistency within their own beef finishing systems.



Figure 3: Automated handling system for data measurement and recording (Decatur County Feed Yard, Kansas, USA).

Jerry Wulf, of Wulf Limousin, has implemented an innovative system of supplying high quality Limousin semen to dairy herds in California, and operating a buy-back contract for the resultant Jersey x Limousin calves. In this way Wulf Limousin benefits from the genetic consistency provided by the Jersey bloodlines, guaranteeing a uniform supply of calves, which perform consistently in the feedlot (see photos in Figure 4 on next page). This system also benefits the dairies, as the price paid for calves is equivalent to that paid for purebred dairy calves. By giving a value to calves which would otherwise be considered 'valueless' by the dairy industry, this type of integration provides a financial incentive for dairy farmers to become more closely linked to the beef industry, as suppliers of calves which produce a high quality consistent beef product.

At Rangers Valley, Australia, Don Mackay operated a similar system, although in this case Rangers Valley owned and leased Holstein cows to dairies, supplying high quality Wagu semen for their insemination, to produce beef for the demanding Japanese market (Figure 4, next page). The demand for quality in the Japanese market is extremely high, so by utilising the consistency of carcase traits from the Holstein, along

By giving a value to calves which would otherwise be considered 'valueless' by the dairy industry, this type of integration provides a financial incentive for dairy farmers to become more closely linked to the beef industry



with the high meat quality traits from the Wagu, Rangers Valley ensured that they produced animals which could consistently meet these demands. This was also another example of positive integration between the beef and dairy industries, as offering a lease option supported the successful establishment of dairy businesses that were unable themselves to generate the capital to purchase high quality cows: so again financially linking the interests of the two sectors.

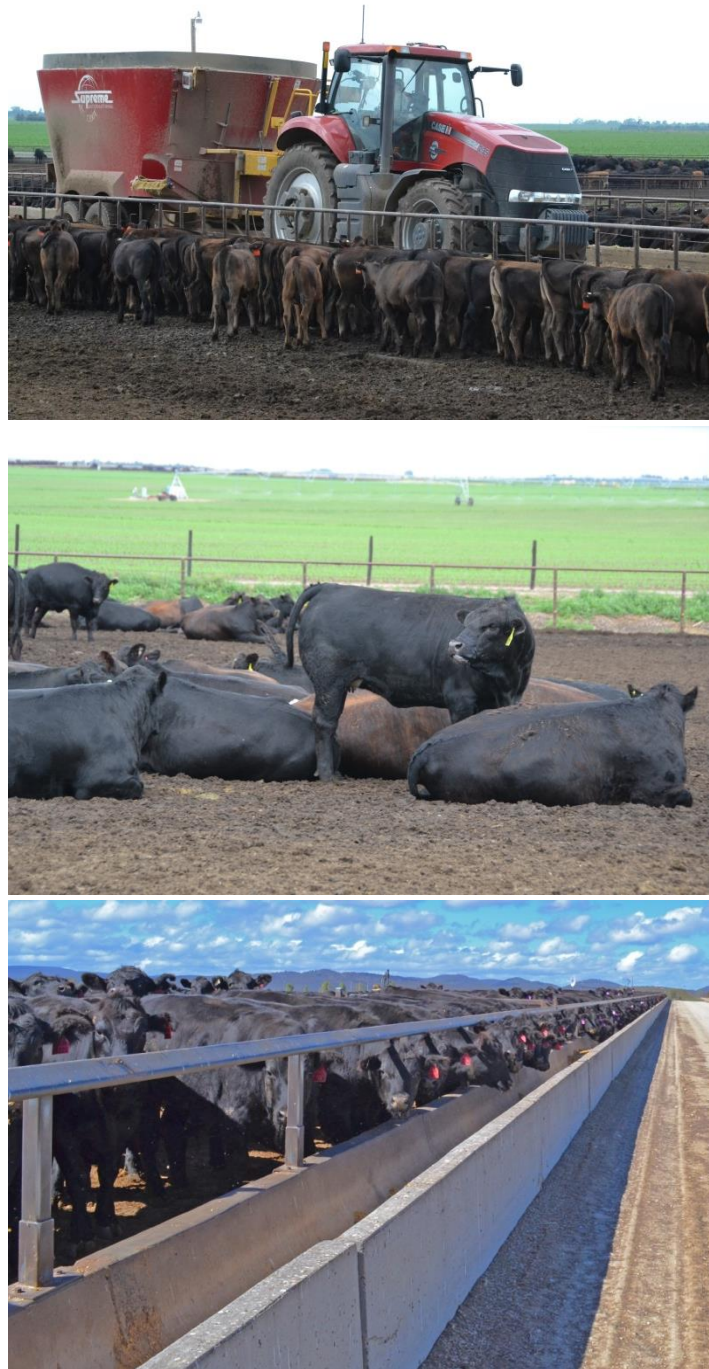


Figure 4: The utilisation of dairy genetics to improve uniformity in finishing cattle
(Upper and central panel - Wulf Limousin, Nebraska, USA,
lower panel – Rangers Valley, New South Wales, Australia)



Product consistency, as previously described, is also relevant to the processors, so integration strategies between processors and producers are beneficial to the industry. JBS is the largest beef finishing group in North America finishing over 900,000 cattle over 6 sites in the USA (*see Figure 5 below*). JBS also own and run their own processing plants, meaning that the business can fulfil the processors' requirement for consistency by controlling the supply and finishing of cattle to its own specification; so cutting down on the issues associated with carcase inconsistency at the processing level.



Figure 5 : 100,000 head beef finishing unit
(JBS Five Rivers Kumer Feed Lot, Colorado, USA)

Australia Country Choice is another huge multi-level business, controlling its own supply and strengthening itself against market volatility by operating a wholly integrated supply chain. ACC farms over 1 million acres of land, owns breeding cows to supply animals into its feed yards, which are then processed at its processing plants. The business model in use by ACC ably demonstrates the benefits of controlling every level of the supply chain, as the carcase consistency observed in its abattoirs must rank amongst the world's best (*Figure 6 overleaf*).

As well as improving or guaranteeing product supply and consistency, the integration of supply chains can mean that businesses are able to take advantage of economies of scale, which is often not an option in small, autonomously-run concerns. Cost reductions benefit all members of the supply chain, including the consumer, who should benefit from cost savings further down the chain driving lower on-shelf prices. This should in turn lead to increased demand for beef, so supporting the growth of businesses and maintaining a profitable supply chain.



Figure 6: Carcase consistency in the abattoir through supply chain integration
(Australia Country Choice, Brisbane, Australia)

5.4. Branding and customer awareness

The consumer is a key element of the beef supply chain, as without a robust demand for beef, businesses cannot continue to flourish. As in other areas of the UK beef supply chain, there is limited consumer feedback, beyond purchasing decisions, on the perceived quality and value for money offered by British beef. Along with a lack of communication from consumer to producer, there is also a lack of producer to consumer promotion in the form of branding. There seems to be an absence of a really strong brand for British beef, which could act as a point of reference for quality amongst consumers. Exceptions to this would be Scottish beef which attracts a retail premium, and the Aberdeen Angus brand which would be reasonably recognisable amongst consumers as signifying high quality beef, but in reality Angus beef makes up a relatively small proportion of beef sales in the UK.

There seems to be an absence of a really strong brand for British beef, which could act as a point of reference for quality amongst consumers.

A more universally recognised UK branding strategy is the 'Red Tractor' labelling system, which recognises British food produced to Assured Farm Standards; however, it is a relatively small feature on packaging, and a significant proportion of consumers may not be fully aware of what the 'Red Tractor' label actually represents. The British beef industry has some of the best animal welfare and traceability regulations in the world, and whilst this is recognised amongst those within the industry, more should be done to make consumers aware of these high standards. Labels like 'Red Tractor' are a good starting point but could be used more effectively to highlight and promote the high welfare standards and provenance of British beef, and to influence consumer purchasing choices.



Our branding strategies contrast sharply with those in the USA, where the beef grading system is based on eating quality (the grading criteria are discussed in detail in Chapter 8). The grade standards are designed to facilitate the marketing of beef to the consumer and beef grades are considered an important selection criterion for consumers, directly influencing purchasing decisions. The universal use of highly visible and recognisable quality grades such as 'Prime', 'Choice' and 'Select' demonstrates that a prominent branding strategy (Figure 7, below) with a strong, consistent message can be utilised to inform and influence consumer purchasing choices.

The British beef industry has some of the best animal welfare and traceability regulations in the world, and whilst this is recognised amongst those within the industry, more should be done to make consumers aware of these high standards.



Figure 7. The prominence and visibility of labelling on UK (upper panel) compared to USA (lower panel) packaging



5.5. Discussion: the beef supply chain

My visits to USA and Australia highlighted to me the benefits of supply chain integration on the quality, consistency and value of beef. In its current fragmented state, the UK beef industry is unable to take advantage of the financial benefits offered by economies of scale, and has neither the communication nor integration between supply chain elements needed to provide consistency and quality in the beef we produce. In my opinion the UK beef sector would benefit greatly from greater communication and integration across all levels of the supply chain. This would facilitate the development of a common aim - the production of a consistently high quality product which represents good value for money for British consumers. The establishment of such a product could then provide the basis for a new brand for British beef, which should represent a high quality product, produced to the highest welfare and traceability standards, giving consumers confidence in their purchases, and working to counter the recent drops in sales of British beef.

My visits to USA and Australia highlighted to me the benefits of supply chain integration on the quality, consistency and value of beef



6. Beef cattle breeding

6.1. The development of reproductive technologies

Farmers have used selective breeding for many hundreds of years to improve the quality of their stock. In recent times, the advent of reproductive technologies has revolutionised cattle breeding. Artificial Insemination (AI) has given breeders access to the very best sires from around the world, through the collection and sale of semen, meaning sire choices are no longer limited by geographical restraints. Ovum flushing and surrogacy now means that a number of offspring from an exceptional female can be produced in a single year, and methods such as synchronisation for block calving have been developed to make management easier.

6.2. Estimated Breeding Values (EBVs)

Along with these physical technologies, the generation and use of Estimated Breeding Values (EBVs) for breeding animals is becoming more commonplace. EBVs are an assessment of an animal's breeding potential for a specific trait. They are calculated using pedigree and performance data including:

Performance traits – these are measurements taken from an animal, its herd mates and its relatives

Trait correlation – the strength of association between different traits. Correlations can be useful in predicting an EBV for a trait for which there is limited available data. By using available data on a highly correlated trait, the accuracy of an EBV can be improved.

Heritability – the degree to which a trait is passed from one generation to the next. The known heritability of a trait can be used to predict performance in offspring from parental data.

The data is then analysed using Best Linear Unbiased Prediction (BLUP), a statistical calculation which generates an EBV. EBVs are expressed in the units of measurement for a specific trait e.g. an EBV for birth weight is measured in kg. EBVs are expressed relative to a common baseline of zero, which represents an historic average value for the trait in each specific breed. EBVs are used to compare the breeding potential of different animals within the same breed by estimating the genetic worth an animal will pass on to its offspring (13, 14).⁵

6.3. Breeding choices in the UK beef industry

The use of EBVs is increasing amongst breeders in the UK, with the use of output EBVs to influence breeding choices. Output EBVs focus on traits such as birth weight, growth rate and daily live weight gain. Traits such as these are easy to measure with the equipment which most producers have available to them on farm, e.g. a crush with a weigh scales, and access to simple software such as

⁵ *For all reference figures quoted in brackets please refer to Chapter 14, on page 44, to check the source
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Microsoft Excel. Output EBVs can certainly be used to predict a number of traits in offspring, and in this way they ably demonstrate the value and benefit of measuring, recording and disseminating breeding information as EBVs. They also undoubtedly make breeding decisions easier and more calculated for producers, and allow the comparison of numerous animals within a particular breed. There has also been a recent drive to develop EBVs which allow direct comparison of animals of different breeds, which will further enhance the value of such data to the producer and should lead to the improved quality of beef cattle breeding in the UK if there is sufficient uptake of the technology.

However, there remains a major caveat to the current use of EBVs in the UK beef industry. Output EBVs do not measure or relate to efficiency (and therefore profitability). As an example, consider growth rate, a value easily measured on farm and a commonly used value to generate an output EBV. Animals with a high growth rate score a high EBV, but there is no consideration of feed intake in this value. An animal with a high growth rate may grow quickly, but it may have a significantly higher feed intake than other animals in order to achieve such growth. The measure of feed intake would be classed as an input rather than an output trait.

Input traits such as net feed efficiency, cow longevity, docility, and calving ease are difficult to measure, and this is why they are not widely used. However they have far more value in terms of predicting efficiency, which is directly related to profitability, than do output EBVs, which provide data on a highly visible, measurable outcome, but do not factor in the 'cost' of each measured output trait.

(Input EBVs) have far more value in terms of predicting efficiency, which is directly related to profitability, than do output EBVs

Another factor which negates the use of input traits in the UK beef industry is that the traits measured by these values tend to be of low heritability. The way to improve the heritability of such traits is to introduce increased genetic variation in offspring. The introduction of hybrid vigour, also termed heterosis, increases fitness in offspring as a result of increased genetic diversity. There is an undeniable understanding in the UK beef industry of the benefits of cross breeding. However the strong interest in purebred animals, supported by breed societies, along with a prevailing traditional view that 'Heinz 57' cross-bred sires are of lower value than purebreds, means that there is a limited interest in the development of composite (or hybrid) terminal sires, to improve the heritability of traits which could potentially improve efficiency, and so cut costs, in many breeding systems in the UK beef sector.

6.4. The use of composite breeding strategies

The generation of a composite breed is not simply a random process of cross breeding; it is a carefully calculated process of trait selection for the desired outcomes in a particular system. A composite is defined as a breed made up of two or more component breeds, designed to retain hybrid vigour (heterosis) without the need for further crossbreeding. Composite breeds, once established, are maintained essentially in the same manner as pure breeds. There is a strong interest in composite breeding amongst producers in the USA beef industry, for a range of outputs including breeding for a specific environment and for high commercial performance.



6.4.1. The Beefmaster: a composite breed for hot and dry environments

The concept of composite breeding is not new to the USA industry. The Beefmaster was the first American composite breed, when it was established in 1931 by Tom Lasater. The development of the Beefmaster was based around selection for 6 traits directly linked to economic value, and excluded selection for any aesthetic traits such as colour. The selection of animals was performed based on disposition, fertility, weight, conformation, hardiness and milk production, generating a breed which couples strong maternal traits with excellent growth and carcase qualities. The Beefmaster composite breeding is half Bos Taurus (25% Hereford, 25% Shorthorn) and half Bos Indicus (50% Brahman), producing a moderately sized, heat and drought resistant animal, which is capable of raising high quality calves in challenging environments (*Figure 8*). The foundation Beefmaster herd was closed to outside genetics in 1937, and the breed was recognised by the USDA in 1954 (15)⁶.



Figure 8: Beefmaster bull (Swinging 'B' Ranch, Axtell, Texas)

6.4.2. Use of genetic technologies to measure the benefits of composite breeding

David Nichols of Iowa is one of the largest seed stock producers in the Mid-West and is a highly respected figure within the USA beef industry. Nichols Farms Superior Beef Genetics produces around 600 purebred and composite bulls each year. Nichols Farms is particularly interested in composite bull breeding, currently developing 3 hybrids, of which two are F1 (Angus x South Devon and Angus x Black Simmental) and the third is an F2 (the product of crossbreeding the two F1 hybrids). Following weaning at around 205 days, every bull calf at Nichols Farms is brought into the feedlot and trialled for weight gain. Genetic analysis is also performed on every bull using a 50k DNA chip. A DNA chip is a method of genetic analysis, which uses a sample from the bull to measure the

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expression of particular genes or gene variants. 50k chips contain 50,000 probes, short genetic sequences which are complementary to the genes of interest. After processing, data analysis can be used to look at the expression of particular genes or gene variants in the individual. Nichols Farms are interested in production efficiency, so the 50k chips are designed to look at expression of genes known to affect production traits. Bulls not reaching the minimum performance criteria set out by Nichols Farms are castrated and sent for feedlot finishing, ensuring that only the best sires are selected for further breeding. The aim of the Nichols composite breeding programme is to produce black, composite cattle, which can offer better performance than purebreds. The use of these breeding strategies at Nichols farms currently sees composite-bred calves weaned approximately 25–50kg heavier than purebred calves (Figure 9 below), clearly demonstrating that the principles of genetic and performance analysis are providing measurable improvements in productivity from composite cattle.



Figure 9 : Size comparison of a composite calf (left) and a purebred calf (right)

6.4.3. Balancing genetic traits for improved performance

Steve and Penny Radakovich, of Earlham, Iowa, are highly respected seedstock breeders within the USA industry, producing composite cattle for the commercial market. Steve was the recipient of a Beef Improvement Group (BIF) Pioneer Award in 2014, in acknowledgement of his contribution to beef cattle improvement. The Radakovich Cattle Company (RCC) goal is to '*balance performance traits by moderating extremes to best utilise farm and ranch resources*'.

The RCC programme aims to fulfil customer demand by utilising the appropriate genetics to balance production and eliminate problems from the system. This has resulted in the development of the two RCC composites known as Red and Black Adaptors. Black Adaptors are a composite aimed at adding heterosis whilst maintaining the black Angus-like appearance (Figure 10), whilst Red



Adaptors are a heat-tolerant commercial composite suitable for conditions in the southern Midwest, where black cattle may not thrive. An interesting philosophy is applied to breeding at RCC, whereby fitness is assessed by selection under 'challenging' conditions. Steve maintains seedstock should be selected under pressure equivalent to or harsher than the pressure in commercial environments, producing animals which are fit for purpose. He believes that in many seedstock operations, the provision of abundant feed and easy conditions means there is an absence of selection pressure for performance, and that no improvement will take place in the absence of real selection pressure. Instead of focusing on large, impressive looking cattle, RCC produces composites with balanced performance traits that are capable of high performance in a commercial environment.



Figure 10 : Black Adaptor heifer (RCC, Earlham, Iowa).

6.5. Discussion re beef cattle breeding

For over 80 years, the USA beef industry has used cross-breeding to improve commercial beef cattle through composite breeding strategies to introduce heterosis. Whilst the UK industry has yet to develop its own composite cattle breeds, an American composite breed has been established here.

The Stabilizer composite was developed as a result of a research project at the Meat Animal Research Centre (MARC) in Nebraska, which started in 1973 and is still in action today. The Germ Plasm Utilisation (GPU) project was initiated to study the impact of heterosis (hybrid vigour) on traits linked to beef production. Based on one of the composites developed for the study, the MARC II, a commercial cattleman in Nebraska was encouraged to develop a four-way cross of half British and half Continental breeds, which would become known as the Stabilizer. In 1988, Leachman Cattle of Colorado began purchasing and marketing Stabilizer cattle. Since that time they have continued to



adapt the composite, selecting for traits including good post-weaning gain, increased rib eye area and marbling and reduced birthweight (16).^{7*}

The Stabiliser Cattle Company (SCC) was formed in 1996 by a group of 5 Yorkshire beef producers in an effort to develop an improved suckler-type cow, decrease reliance on dairy-bred cows and increase production efficiency. The Leachman Stabiliser was selected as the basis for this breeding programme, and the SCC is now producing UK Stabiliser breeding stock. The SCC composite breeding programme is aimed at improving the economic production of high eating quality beef, through the delivery of a cost-effective suckler cow system (17)^{8*}.

Whilst the ongoing establishment of a Stabiliser herd in the UK is a positive step in improving efficiency within the UK suckler herd, the UK beef industry could benefit from using composite breeding strategies for bull breeding. The USA composite breeding programmes I observed on my study demonstrated the improvements which can be made in beef cattle breeding through the development of composite terminal sires, selected for input traits such as feed efficiency. Similar programmes in the UK focused on the breeding of composite terminal sires with high feed efficiencies, producing high quality beef could make a significant contribution to the improvement of beef cattle in the UK.

⁷ *For all reference figures quoted in brackets please refer to Chapter 14, on page 44, to check the source

⁸ *For all reference figures quoted in brackets please refer to Chapter 14, on page 44, to check the source



7. Efficiency in beef finishing systems

7.1. Introduction

As costs increase, efficiency within beef production systems must be improved in order to avoid further increases in on-shelf prices, which could prove damaging for beef sales in the UK. In this chapter I will examine the typical beef finishing system currently used in the UK and discuss the ways in which other beef industries from around the world are developing new protocols to improve the efficiency of beef production.

7.2. Feed conversion efficiency

Feed conversion efficiency is a measure of the dry matter intake (DMI) required to achieve 1kg of live weight gain. Feed conversion efficiency is variable in different animals. During the finishing phase of cattle production, most producers will aim for a target DMI of 2% of an animal's body weight. Consuming this amount of dry matter will result in a weight gain of around 1.4kg per day in a healthy animal. Feed efficiency reduces with increased body size because as cattle grow, the amount of dry matter equivalent to 2% of body weight increases, but their daily weight gain remains static at around 1.4kg per day. This means that as cattle grow, they require more feed to achieve a target weight gain of 1.4kg per day. Therefore the cost of production (feed costs) increases as body size increases, whilst feed conversion efficiency is negatively correlated with body size (*Figure 11 below*).

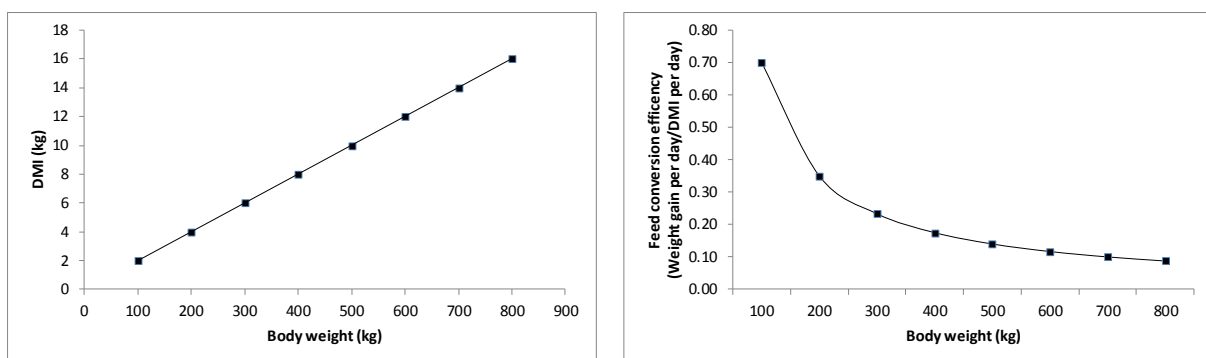


Figure 11: Graphs showing the relationship between body weight and DMI (left panel) and body weight and feed conversion efficiency (right panel)

7.3. The UK store period and its effects on efficiency

7.3.1. The BSPS Scheme 22 month payment

As feed efficiency is negatively correlated with body size, younger, smaller animals are able to convert feed more efficiently than older, larger cattle. This means that finishing smaller, lighter cattle would allow farmers to utilise the period of maximum feed efficiency, in order to keep feed costs down. However, in the UK, the historic route to slaughter for beef animals typically sees an extended store period after weaning, before older cattle are finished at high weights (around 750kg



live weight is common). It is normal for the store period to take place on one or two different farms, over a period of 12–16 months. Historically, an extended store period in the UK was driven by production-linked subsidies such as the Beef Special Premium Scheme. The second payment of the BPS was paid on cattle of 22 month of age, thus providing an incentive for producers to maintain cattle to this age. Despite the BPS scheme being succeeded in 2005 by the SFP scheme, the tendency to maintain cattle in an extended store period before finishing still remains. Prior to CAP reform, the second BPS payment may have balanced the costs of an extended store period, but in the current climate, there is no financial incentive to maintain it. In fact an extended store period should be classed as one of the most significant contributing factors to the high cost of beef production in the UK today, due to the negative correlation of feed conversion efficiency with increasing body size.

In fact an extended store period should be classed as one of the most significant contributing factors to the high cost of beef production in the UK today, due to the negative correlation of feed conversion efficiency with increasing body size.

7.3.2. The effects of high finishing weights on feed and fixed costs in the UK beef sector

Following an extended store period, older, heavier cattle enter the finishing period at a point when feed conversion efficiency is declining. As DMI increases with body size, the cost to feed bigger animals is higher than the cost to feed smaller cattle in order to achieve the same weight gain per day. It should also be considered that 75% of DMI is used for maintenance, rather than growth (*Figure 12 on next page*). In the current UK operating system, this means that there is a significant feed cost associated with maintenance alone, which could be reduced if cattle were finished to lighter weights. Fixed costs per head (factors such as bedding and labour) are also higher when finishing larger cattle, as fewer animals can be maintained in the same amount of space, meaning the fixed costs must be shared over a smaller number of animals. When feed and fixed costs are considered, the ‘cost of gain’ increases with increasing body weight and this highlights the inefficiency of our current system.

... many producers will not be aware of the sharp decline in feed conversion efficiency or the increased cost of gain in larger animals.

The extended store period typically operated in the UK is a historic legacy from the pre-CAP reform days of the BPS 22-month payment, and the traditional grass-based slow fattening systems operated in the past. However, in the absence of financial incentives to maintain an extended store period, the knowledge of declining efficiency in larger animals should be sufficient to drive reform

amongst UK beef producers. However, few beef producers are likely to calculate the cost to finish each animal, so many producers will not be aware of the sharp decline in feed conversion efficiency or the increased cost of gain in larger animals. Furthermore, despite increasing demand for smaller carcass weights amongst processors, there is currently no financial reward for producing animals to a desired (lighter) weight. In the absence of both knowledge and incentive to finish younger, lighter



cattle, many UK producers will continue using their current protocols, thus maintaining the high cost to finish cattle and subsequent high on-shelf prices.

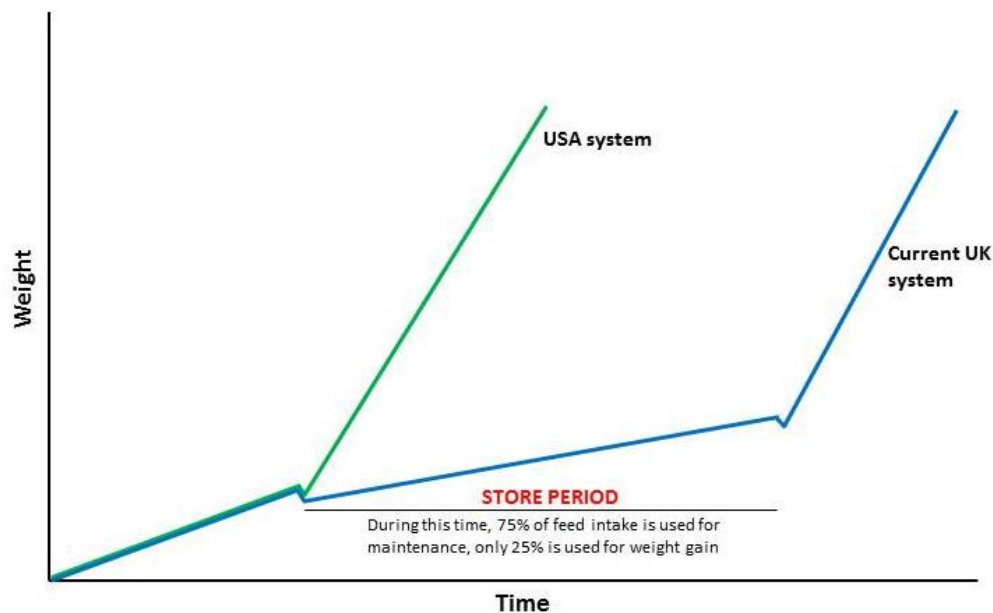


Figure 12: Graph showing weight gain over time in the current UK finishing system (blue), the comparable weight gain over time in the USA finishing system (no store period) is shown in green.

On my Nuffield Farming study tour of the USA, I observed some interesting practices aimed at improving efficiency within beef finishing, a number of which could be utilised for improved efficiency in the UK.

7.4. Methods for increasing efficiency in the USA beef industry

7.4.1. The use of growth hormones

The use of hormones to promote growth is permitted in the USA. Most cattle are treated with hormones, although a small proportion of cattle are produced hormone- and antibiotic-free (non hormone treated cattle - NHTC) for the European market. There is around a 10% increase in feed conversion efficiency in hormone-treated cattle compared to NHTC cattle, so the effect of hormone treatment on feed conversion, and therefore feed costs, is significant. Hormone treatment is prohibited in the UK, so is currently not a viable option for UK producers aiming to improve efficiency in their systems. However, due to its prevalence, it is important to consider the implications of hormone use when studying other practices to increase efficiency in the USA beef industry, as additive effects on efficiency in these systems may not necessarily be replicated in the absence of hormone treatment.

7.4.2. Feed preparation for increased efficiency

Grain maize is a common feed source in feedlots in the USA. The process of steam flaking (pre-treatment with steam prior to rolling) enhances digestibility and increases the metabolisable energy

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content of maize. This increases starch uptake in the rumen and across the whole digestive tract, decreases the average feed:gain ratio, and improves growth performance in cattle (18).^{9*} Grain maize is not a common ration component for finishing cattle in the UK, but it is possible to steam flake wheat and barley, both of which are typical UK ration components. For steam flaking to be considered a viable practice in the UK, the benefits gained from improved palatability and digestibility would need to be balanced against the cost of the energy required to generate steam.

7.4.3. Using technology to understand feed conversion efficiency

A major issue in many UK systems is that few producers will calculate the feed conversion efficiencies of their animals during the finishing period, so will not be aware of the 'cost to finish'. Without this knowledge it is difficult to make improvements to the system, either by changing rations, protocols or the type of cattle finished.

.. few producers will calculate the feed conversion efficiencies of their animals during the finishing period, so will not be aware of the 'cost to finish'.

During my study tour of the USA I observed a number of producers utilising the 'GrowSafe' system to study feed conversion efficiency on an individual animal basis.

GrowSafe was developed in Canada (19)^{10*} and operates a system of individual bunks, which open in response to the EID tag of the animal being trialled. The feed is weighed to work out intake, and the animal is also weighed to calculate weight gain. This means that feed conversion efficiencies can be calculated and used to influence breeding decisions, helping to make high feed conversion efficiency a target in commercial cattle breeding.

GrowSafe also have a similar system for monitoring water consumption and hypothesise that this can be used as an early indicator of illness. Reduced water consumption is considered a clear marker of illness, and the system allows medication via water, or simply acts to indicate the requirement for medical intervention. The water-based system is also proposed to aid efficiency, as it facilitates early treatment, which should reduce the severity and period of illness, so reducing the cost of medication and restoring appetite and weight gain as soon as possible.

A limited number of producers in the UK are utilising the GrowSafe system to calculate individual animal feed conversion efficiencies. The Beef Improvement Group, based in North Yorkshire, are using the GrowSafe feed system in feed conversion efficiency trials for Stabiliser cattle (see Chapter 6 for a background to the Stabiliser breed).

7.4.4. Finishing young cattle to increase efficiency

As described in 7.2 and 7.3, feed conversion efficiency declines with increasing body size, so finishing larger cattle with sub-optimum feed conversion efficiencies increases the 'cost of gain' compared to that of smaller animals. Finished cattle in the USA are generally significantly smaller than those in

⁹ *For all reference figures quoted in brackets please refer to Chapter 14, on page 44, to check the source

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the UK, and many producers take weaned calves straight into the feedlot for finishing, rather than turning out to grass for a store period. The typical daily weight gain of a store animal at grass in the UK is less than 1kg per day, around 66% of the weight gain achieved during the finishing period. The USA system dispenses with this 'low gain' store period, beginning the finishing period much earlier instead, and targeting high weight gains early. The major economic advantage to finishing smaller cattle is that this system allows producers to take advantage of the high feed conversion efficiency in lighter cattle, so dramatically reducing their 'cost of gain' compared to finishing heavier animals. Further benefits include the ability to finish more animals in the same area, so reducing fixed costs per head.

Some producers in the UK beef industry remain cynical about the ability to take weaned cattle straight onto feed without a store period out at grass to build frame. However, most producers in the USA operate in this manner, producing high quality beef profitably. As previously described in Chapter 5, Jerry Wulf, of Wulf Limousin in North Nebraska, has developed a method of supplying dairy-cross calves into his feedlots by building partnerships with dairies in California. Jersey x Limousin calves destined for the feedlot are taken off their mothers at 1–2 days of age. They are moved to calf rearing facilities where they are started on feed at an early age. Calves arrive at the feedlot weighing around 130–140kg, where they are fed on a 'starter' ration for around 90-100 days. At this point calves are sorted by size and receive an increased ration.

After around 150 days in the feedlot, cattle weigh around 320kg and are fed a 'grower' ration, which they are fed until they reach 380–400kg body weight. Cattle are then fed a 'finishing' ration which contains corn, earlage (maize silage), wet distillers, roughage and minerals (with rumensin). Cattle reach weights of around 450kg after approximately 220 days in the feedlot. Two finishing rations are used, the second one having a higher earlage content, until cattle reach a target finished weight of around 590–620kg.

Compared to USA finished weights, typical UK finished cattle weights are around 100–150kg higher. In fact, many cattle in the UK leave the store period at a weight similar to the USA finished weight. The graphs in Figure 13 below compare an example USA finishing period to an example UK finishing period. This clearly demonstrates that the USA system operates during a period of lower DMI and better feed conversion efficiency.

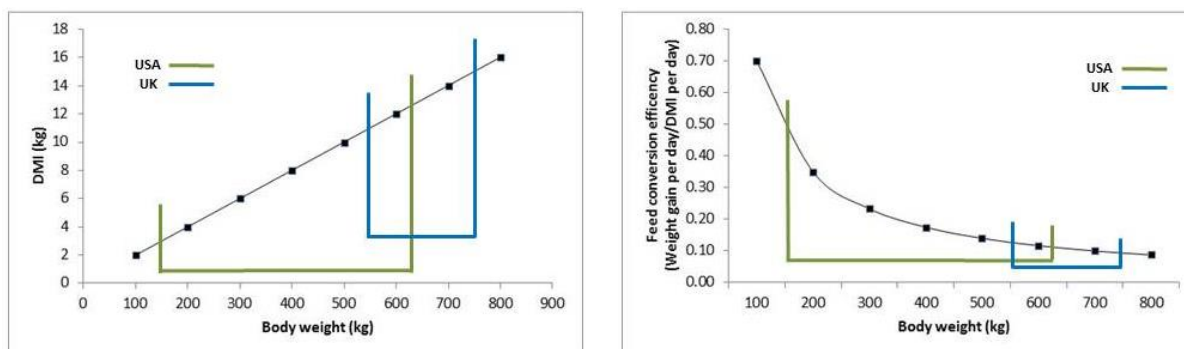


Figure13: Graphs showing the relationship between body weight and DMI (left panel) and body weight and feed conversion efficiency (right panel). The cattle body weights utilised by the USA and UK industries are indicated by the coloured lines (USA = green, UK = blue)



As described in 7.4.1, there are differences in the USA and UK systems, including the use of hormones (and rumensin), both of which are prohibited in the UK. However approximately 50% of cattle at Wulf Limousin's Eagle's Creek feed yard are NHTC, but are still finished according to the system described above. It is therefore possible to finish lighter cattle at a younger age operating in a system which would be permitted in the UK (eg hormone-free).

7.5. Discussion re efficiency in beef finishing

In the future the increasing cost of feed and other inputs is likely to continue, driven by an increasing global population, decreasing acreage for crop and livestock production, and increased utilisation of food crops for fuel. The UK beef industry must work to implement a more efficient finishing system, in order to maintain profitability in an increasingly challenging market place. I believe that to do this, producers must work to understand the current efficiency level of their own systems, and implement new strategies to improve efficiency in order to cut production costs. Industry-wide, the adoption of a new production regime, based on the USA system, should improve efficiency for every producer. Moving away from the traditional extended store period, to finish smaller, lighter cattle would allow producers to take advantage of the optimum period of feed conversion efficiency in each animal's lifetime.

In our current system, we miss this opportunity, as cattle are in the store period, delivering low daily weight gain from a grass-based diet. By taking younger animals straight into the finishing period, we can utilise high feed conversion efficiency, to produce target weigh gains from lower feed inputs, thus significantly reducing the 'cost of gain' by lowering input costs. As well as cost cutting within the production system, finishing smaller, lighter animals would also better fulfil both processor and consumer demands. Average portion sizes have fallen in recent years, meaning

By taking younger animals straight into the finishing period, we can utilise high feed conversion efficiency, to produce target weigh gains from lower feed inputs

processors prefer smaller carcasses, in order to achieve cuts of the correct size and thickness to fulfil customer demand and maintain the quality of the eating experience. Reducing the cost of production should also help maintain a competitive on-shelf price, meeting customer demand for value for money and maintaining or potentially increasing demand for British beef.



8. Grading

8.1. The Beef Carcase Classification Scheme and the EUROP Grid

All UK abattoirs slaughtering more than 75 adult cattle per week must be registered and comply with the regulations of the Beef Carcase Classification (BCC) Scheme. This scheme requires the grading of all carcasses on a scale known as the EUROP Grid, and is designed to ensure uniform classification of carcasses and guarantee fair payments for all producers based on a standardised measure of carcase quality (20)¹¹.*

8.1.1. Grading and payment criteria of the EUROP grid

The EUROP Grid pays producers on a pence/kg basis, based on carcase scoring on the EUROP Grid criteria. Following slaughter and evisceration, carcasses are hung, weighed hot and cold, and graded on conformation and external fat cover. Conformation is scored from superior/excellent, through to poor, with the highest prices paid for the highest conformational grades. Carcasses are also scored on external fat cover, with very low (grade 1) or very high fat cover (grade 5) being financially penalised. It is however interesting to note that different abattoirs choose to penalise carcasses at different grades on the fat scale. Whilst some abattoirs will penalise a 4H grade carcase, others will not apply a financial penalty unless a carcase grades at Grade 5. After weighing and grading, producers are paid for the cold carcase weight, at a pence/kg amount according to the carcase score on the EUROP grading scale.

The grading classifications of the EUROP Grid are shown in Figure 14 overleaf. The subdivisions detailed below apply to the standard grading scale. Some abattoirs will, however, choose to adopt a more detailed system of subdivisions, known as the 15-point scale. Using this system, each conformation and fat class is subdivided into low (-), medium (mid) or high (+). The use of the 15-point scale is said to allow more accurate carcase grading (20).¹²*

Whilst the EUROP Grid significantly contributes to the fair and standardised grading of beef carcasses in the UK and across the European Union (EU), it should be borne in mind that the principles upon which the EUROP grading system are based do not relate to two fundamental factors in beef production:

- 1) the eating quality of beef and
- 2) meat yield.

The use of the EUROP grading system over a lengthy time period means that the Grid has had a significant and some would say detrimental, effect on beef production in the UK.

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¹² *For all reference figures quoted in brackets please refer to Chapter 14, on page 44, to check the source
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Classification	Carcase quality	Subdivision
S	Superior	
E	Excellent	
U	Very good/Up-rated	Upper (+) or lower (-)
R	Good/Regular	
O	Fair/Ordinary	Upper (+) or lower (-)
P	Poor	Upper (+) or lower (-)

Classification	Fat cover	Subdivision
1	Low	
2	Slight	
3	Average	
4	High	Leaner (L) or fatter (F)
5	Very high	Leaner (L) or fatter (F)

Figure 14: The EUROP Grid classification of carcass conformation (upper panel) and fat cover (lower panel).

Adapted from <https://www.gov.uk/the-beef-carcass-classification-scheme-classify-carcasses> (19).

8.1.2. Beef eating quality

The core basis of conformational grading under the EUROP Grid is a superficial examination of conformation or shape, mainly focusing on the top line and rump of the carcass. It is interesting to note that whilst the grading system is strongly focused on the rump, it is actually the loin which produces the most valuable cuts of beef. Wholesale values of beef from the loin are on average 1.5 - 3 times more expensive than cuts from the rump (*Figure 15 below*).

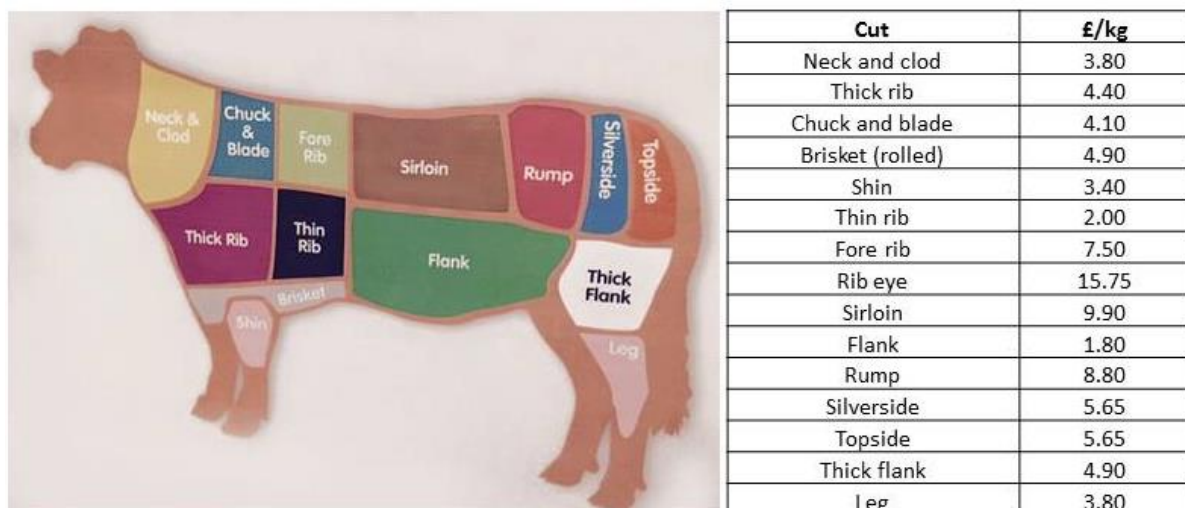


Figure 15: Wholesale prices for beef cuts (22/07/15).
Information from TS Hartley and Sons Ltd, Tholthorpe, York



High payments for large, double muscled hind quarters have driven UK farmers to produce animals which grade well under the EUROP grid. Higher conformational grades on the EUROP grid tend to correlate with lean meat yield, and increased lean meat yield correlates negatively with the amount of intramuscular fat. Intramuscular fat is a major factor in meat taste and tenderness, so a drive to breed leaner animals with reduced intramuscular fat is detrimental to the eating quality of beef. Therefore, under the current UK system of grading using the EUROP Grid, there is greater financial benefit for farmers to produce carcasses with reduced eating quality due to reduced intramuscular fat.

Therefore, under the current UK system of grading using the EUROP Grid, there is greater financial benefit for farmers to produce carcasses with reduced eating quality due to reduced intramuscular fat.

Eating quality is further reduced by the current system as farmers aim to produce larger cattle in order to receive the highest payment possible per animal reared. However larger animals produce larger meat cuts, and this is particularly problematic when beef is sold in portion sizes, based on weight. The only way to achieve the correct weight for a particular portion/serving size is to reduce the thickness of a larger cut of meat. This has a negative impact on beef eating quality as thinner cuts do not cook as well as thicker ones, tending to overcook and quickly become tough.

It is most concerning that through the use of the EUROP Grading system, the UK beef industry continues to overlook the most important factor in beef production – the taste and quality of the

It is most concerning that through the use of the EUROP Grading system, the UK beef industry continues to overlook the most important factor in beef production – the taste and quality of the end product.

end product. In times of economic hardship, the production of consistent, high quality, tasty beef is even more important, as consumers must be convinced of good value for money if they are to continue to purchase high price products such as beef. On the point of eating quality, the EUROP Grid is failing both consumers and producers, by not guaranteeing a consistent, high quality product on the shelves and by not providing financial incentives to produce a high quality product.

8.1.3. Meat yield

Another key area in which the EUROP grading system is failing the UK beef industry is the lack of assessment of meat yield from carcasses. As there is no direct measure of saleable meat yield, the EUROP Grid conformational grades do not take into consideration or relate directly to meat yield, and increased meat yield is not rewarded by higher pence/kg payments (*Figure 16 overleaf*). In fact, the lack of measurement of saleable meat yield means the current grading system is particularly flawed when applied to large-framed, heavily-boned breeds such as Simmental and Charollais, which



will have reduced meat yield compared to lighter-framed cattle of the same size carcass, due to increased bone size.

Killing out percentage	Grade
56.85	R 3
55.68	R 4H
54.82	-U 3
53.68	-U 4L

Figure 16: Kill out percentage and grades for cattle from Myton Hall Farms demonstrating that conformational grade does not directly reflect KO%. (Representative values from 30 cattle, killed 9 July at Woodheads, Colne).

For the processor, high meat yield is one of the most important features of a carcass, as high meat yield will reduce the production cost/kg of meat, a saving which can either be passed on to the consumer, so increasing sales, or retained by the processor, so increasing the profit/kg of meat sold. A fit-for-purpose grading system should act to reward the production of high meat yield carcasses, by linking payments to meat yield. This would encourage farmers to produce high yielding carcasses, and assist in the maintenance of a competitive on-shelf price due to reduced relative processing costs.

8.1.4. Animal welfare and management implications

Alongside the key considerations of eating quality and meat yield, the EUROP Grid has impacted on on-farm management of breeding, as farmers strive to produce large, double muscled animals in pursuit of the highest payments. The breeding of such animals has both financial and welfare implications. In animals which grade particularly well under the EUROP Grid, calving difficulties are common, as cows struggle to deliver large calves with large hindquarters unassisted. Apart from the impact on cow health of interventions including assisted-delivery (using a calving jack) or caesarean section, there are associated cost increases related to more veterinary visits/procedures, the requirement for increased working hours during calving time, and the financial losses due to calf deaths after difficult calvings. In my opinion a sound UK grading system should not encourage the breeding of animals that are unlikely to give birth unassisted; this is in accordance with the industry's commitment to high welfare standards for farmed livestock and also because of the increased associated management costs.

*a sound UK grading system
should not encourage the
breeding of animals that are
unlikely to give birth
unassisted*

8.2. The United States Department of Agriculture (USDA) grading system

In 1996 the USDA established the 'Standards for Grades of Slaughter Cattle and Standards for Grades of Carcass Beef.' The standards include two separate grades, one for quality and one for meat yield (Figure 17, next page). Carcasses can be graded for quality or yield, or may receive grades for both factors.

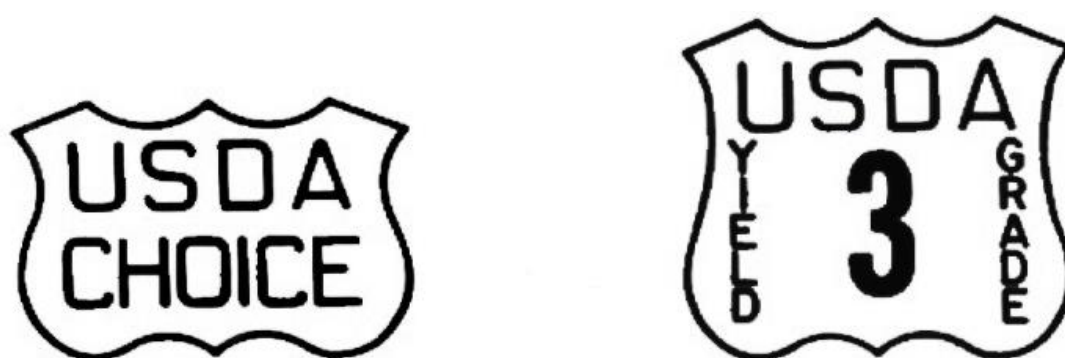


Figure 17 : The labels used for meat graded under the USDA grading system for quality and meat yield (21).

8.2.1. Quality grading

The quality grade in the USDA system refers to the predicted eating quality of the beef when cooked (tenderness, juiciness and flavour are key considerations). The eight USDA quality grades range from Prime (highest quality) to Canner (lowest quality). The USDA Quality grade is determined by measures of physiological maturity and marbling.

Maturity

Maturity is classified into 5 groups, from A (youngest) to E (oldest). The age ranges which correspond to each group are detailed in Figure 18 below.

Maturity is measured by evaluation of:

- Bone and cartilage size, shape and ossification (conversion of cartilage to bone with increasing age).
- Ribeye muscle texture and colour (which darkens and becomes more coarse textured with age)

Maturity Group	Approximate age range (months)
A	9 – 30
B	30 – 42
C	42 – 72
D	72 – 96
E	96 +

Figure 18 : Maturity Groupings for USDA Quality Grading

Marbling

Within a Maturity group, carcass marbling at the 12th rib cross section acts to determine the quality grade. The amount of marbling affects tenderness, juiciness and flavour, so highly marbled beef receives the highest Quality grades. The combination of Maturity and Marbling scores determine the USDA Quality Grade, as detailed in Figure 19 on next page.



Degree of Marbling	Maturity				
	A	B	C	D	E
Slightly abundant	Prime			Commercial	
Moderate					
Modest	Choice				
Small				Utility	
Slight	Select				
Traces					
Practically Devoid	Standard			Cutter	

Figure 19: USDA Beef Quality Grading Chart.
Adapted from www.beefresearch.org/cmdocs/beefresearch/beefgrading.pdf (21)¹³ *

8.2.2. Yield Grade

There are five USDA Yield Grades, which score the lean edible meat yield of a carcass. The Yield Grades run from 1 (highest) to 5 (lowest) and are detailed in Figure 20 below.

Yield Grade	% yield of closely trimmed boneless retail cuts
1	>52.3
2	50 – 52.3
3	47.7 – 50
4	45.4 – 47.7
5	<45.4

Figure 20 : USDA Beef Yield Grading Chart

Yield is measured by:

- External fat thickness over the ribeye
- Ribeye area
- Estimated percentage of kidney, pelvic and heart fat
- Hot carcass weight

The yield grade is determined by an equation taking into account the above factors, which affect and relate to carcass cutability (21)*.

¹³ *For all reference figures quoted in brackets please refer to Chapter 14, on page 44, to check the source
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8.2.3. Concluding remarks

The primary focus of the USDA grading system is eating quality. Beef producers in the USA receive payment depending upon the quality (assessed by grading) of the beef they produce, and the consumer can use the USDA grade as a selection factor during meat purchases, knowing that the grade is reflective of the eating quality of that meat.

8.3. The Meat Standards Australia (MSA) grading system

8.3.1. Rationale for the development of the MSA grading system

The MSA grading system was developed to make the purchase of high quality meat easier for Australian consumers (*Figure 21 below*). The MSA standards cover both beef and sheep meat, and are designed to ensure that all products sold under the MSA symbol meet eating quality standards. The MSA acknowledged the importance of meat quality to the customer experience and was inspired to develop a grading system based upon factors important to the consumer. Over 100,000 consumers were surveyed in order to establish the factors which contribute to a consistently high quality, tender, tasty product. These factors were then used to develop a grading system, where the measurement of key attributes is able to accurately predict eating quality.



Figure 21: The MSA grading system label, which is used on packaging to indicate meat quality (22).

8.3.2. The MSA beef carcass grading system

The MSA beef carcass grading system assesses carcasses on a number of factors including:

- Marbling
- Fat Colour
- Meat Colour
- Maturity (ossification)
- Ultimate pH
- Hump height
- Subcutaneous rib fat



Marbling

Marbling (or intramuscular fat) contributes to the tenderness and juiciness of beef. MSA standards assess the amount, distribution and piece size of marbling in the longissimus dorsi muscle (*Figure 22*).

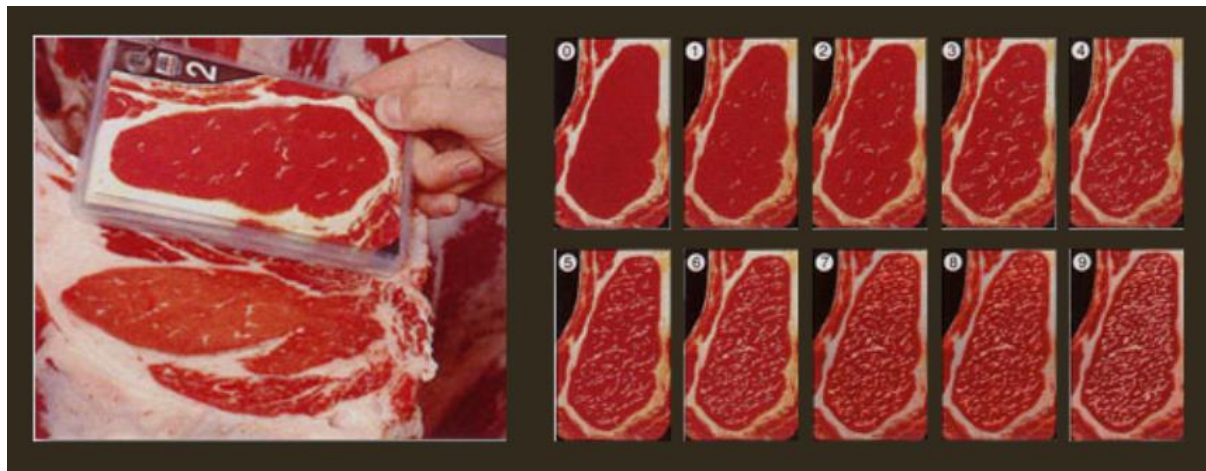


Figure 22 : MSA scale used to measure beef marbling (22)¹⁴ *

Fat colour

Fat colour is measured using a colour chart (*see Figure 23*) and is assessed as the colour of the intermuscular fat lateral to the rib eye muscle. Fat colour is affected by the production regime (either grain or grass fed), which can affect meat taste.

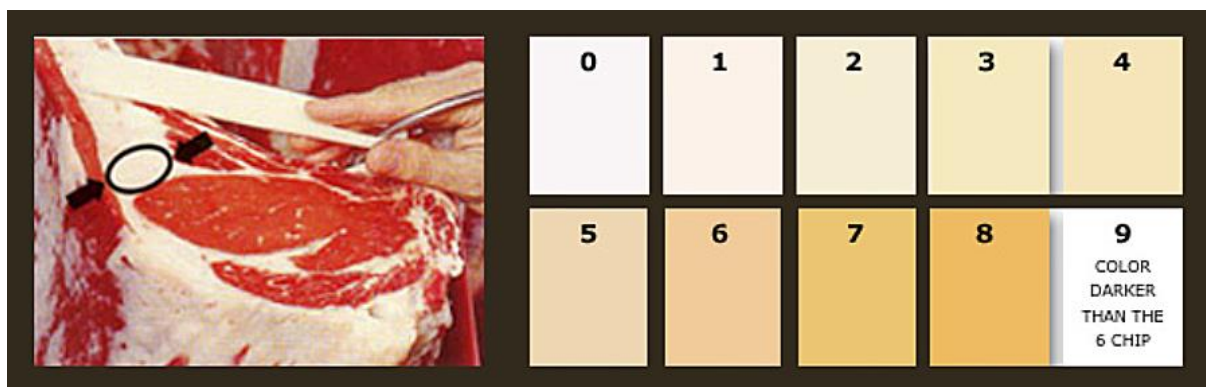


Figure 23 : MSA scale used to assess fat colour (22) *

Meat colour

Meat colour is an indicator of tenderness: the darker the meat the tougher it will be, as dark meat can be an indicator of stress and the release of related hormones such as adrenaline which negatively affect meat quality. The colour of the rib eye muscle is assessed according to the MSA colour standard shown in *Figure 24* on next page.

¹⁴ *For all reference figures quoted in brackets please refer to Chapter 14, on page 44, to check the source *Investigating different farming systems to improve efficiency in the UK beef industry ...* by Richard Pennock A Nuffield Farming Scholarships Trust report ... generously sponsored by The Yorkshire Agricultural Society

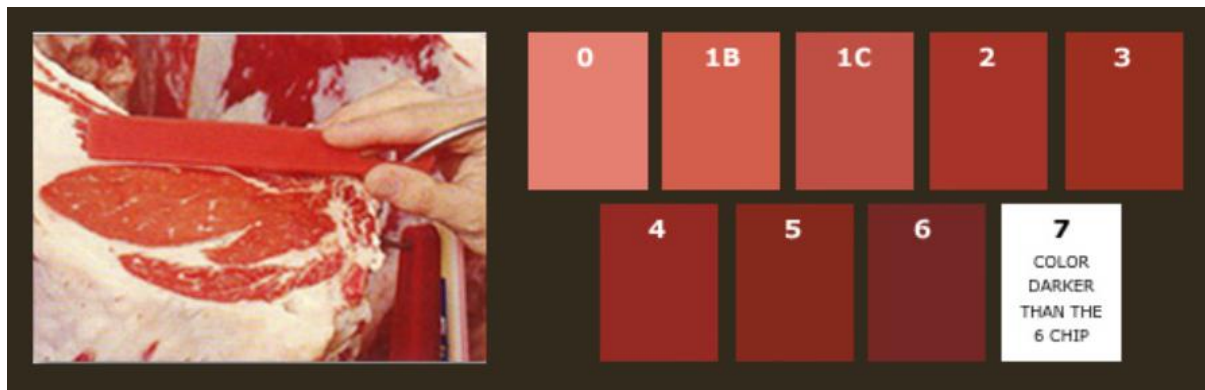


Figure 24: MSA scale used to assess meat colour (22)¹⁵ *

Maturity

Physiological age/maturity is a key factor in beef tenderness. It is assessed by the level of ossification (the conversion of cartilage to bone), a process which occurs during aging and growth.

Ultimate pH

Assessment of the lactic acid content in muscle gives a measure of carcass pH, which is a major indicator of beef eating quality.

Hump height

Tropical breeds are common in Australia, and tend to produce lower quality beef. Hump height is used to assess the tropical breed content of a carcass as an indicator of beef eating quality.

Subcutaneous rib fat

Subcutaneous fat contributes to meat tenderness. MSA grading measures the thickness of rib fat, which must be at least 3mm to meet MSA standards (23).

8.3.3. Interactive factors affecting meat quality

As well as the direct factors described above, the MSA also regulates and measures other interacting factors which can affect meat eating quality. All producers wishing to supply cattle for the MSA must be registered and agree to conform to the handling and transport guidelines stipulated by the MSA. These guidelines include recommendations on the handling of cattle prior to and during transport to slaughter, which include:

- Cattle to be managed as a single herd, with no mixing or drawing, for a minimum of 14 days prior to dispatch for slaughter
- Cattle should be fed on a diet of increasing nutritional value in the 30 days prior to slaughter
- Cattle must have access to water outside of transport, and should have access to feed prior to transport

¹⁵ *For all reference figures quoted in brackets please refer to Chapter 14, on page 44, to check the source *Investigating different farming systems to improve efficiency in the UK beef industry ...* by Richard Pennock A Nuffield Farming Scholarships Trust report ... generously sponsored by The Yorkshire Agricultural Society



- Cattle should be handled quietly and where possible without the use of goads/electric prodders, in order to reduce stress prior to and during loading/unloading
- Cattle of poor temperament will not be eligible for the MSA scheme (due to the likelihood of dark cutting as a result of stress)
- Slaughter should occur within 48 hours of dispatch (for road transport) or the day after for other transport methods
- Transport time should not exceed 36 hours from dispatch to arrival at the abattoir (24)¹⁶ *

8.3.4. Concluding remarks

The development of the MSA grading system was driven by consumer opinion on the factors affecting beef eating quality. The MSA took this information and used it along with industry knowledge to develop one of the most comprehensive grading systems in the world. This system utilises the regulation of pre- and post-slaughter management systems and a detailed carcass grading system to enable the production of an extremely consistent, high quality eating product.

8.4. Discussion re the grading system

During my Nuffield Farming study tour, I visited two countries operating beef grading systems which contrasted starkly with the grading system operated in the UK. Instead of focusing on carcass shape as we do here in the UK, both Australia and the USA have developed grading systems focused solely on eating quality - assessment of the meat, rather than of the animal (or the carcass). Not only is the focus dramatically different in these countries, but the grading system is utilised as a marketing tool, indicating the quality of beef to the consumer.

There are few British consumers who would be aware of the details of the EUROP grid, as it has no relevance to eating quality. In contrast, Australian and American customers are familiar with the grading systems used, and understand the correlation between the grade a piece of beef is given and its eating quality. By grading according to meat quality, Australia and the USA encourage their farmers to produce cattle for high quality, tasty beef. They also empower consumers, by providing information which enables consumers to make purchasing choices, and provides transparency in the pricing systems applied to different beef, justifying higher prices with a better eating experience.

The UK beef industry is currently unable to match Australia or the USA in the production of a consistent, high quality product. I believe this is a direct result of the operation of a grading system which is not fit for purpose, focused as it is on carcass shape, and bearing no relevance to eating quality. By adopting a grading system based on eating quality, the UK beef industry could do much to improve the consistency and quality of the beef we produce, by encouraging producers to focus on beef eating quality, rather than cattle conformation. The development of a fit-for-purpose grading system, with eating quality as its focus, would restore consumer faith in beef as a high quality product, which offers good value for money, and thus may counter the recent reduction in beef sales in the UK.

¹⁶ *For all reference figures quoted in brackets please refer to Chapter 14, on page 44, to check the source
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9. Discussion: the topic in general

During my Nuffield Farming Scholarship study tour, I have had an opportunity to gain an insight into how beef industries around the world are meeting the challenges of a global economic downturn. Production costs are high in the UK beef industry, and high retail prices, along with changed consumer habits, are driving reduced sales of British beef. The industry is also particularly sensitive to commodity price fluctuations, reducing profit even further when global market prices increase. Compared to the UK beef industry, the USA and Australian industries are better able to cope with challenging economic periods. This is partly because the production costs in both these industries are inherently lower than in the UK, due to climate and increased land availability allowing outdoor production of cattle from birth to slaughter. Whilst lack of land availability prevents outdoor finishing for many UK beef producers, there are three major areas in which the USA and Australian beef industries can provide lessons for the UK industry: these are efficiency, integration and industry focus.

Feed is a major production cost in all beef industries, as finishing cattle require the equivalent of 2% of their body weight as daily dry matter intake (DMI). The USA and Australian beef industries, in contrast to the UK, bypass the store period to finish younger, lighter cattle. This utilises the time that cattle convert feed more efficiently, meaning lower feed costs/kg weight gain and reducing the cost to finish compared to UK systems. In contrast, the high finished weights of the UK beef industry often mean that the feed cost/kg gained exceeds the value/kg gained, highlighting the finishing of high weight cattle as an unsustainable system. UK beef cattle breeding also focuses on output traits such as growth rate, rather than input traits such as feed conversion efficiency, which are directly related to production costs and profitability. In the USA beef cattle breeders are utilising composite breeding programmes to increase the heritability of lowly-heritable traits. Targeted breeding strategies aimed at improving efficiency are helping to lower production costs and beef retail prices.

the primary industry focus in both Australia and USA is the production of high eating quality beef, with grading systems and branding strategies directly linked to eating quality.

Much of the UK beef industry breeding strategy is also targeted towards producing animals which will grade well under the EUROP Grid. Grading and producer payment is based on carcase conformation, which is unrelated (or at times detrimental) to eating quality, and where variable quality is common. In sharp contrast the primary industry focus in both Australia and USA is the production of high eating quality beef, with grading systems and branding strategies directly linked to eating quality. This ensures that producers receive the highest prices for producing beef which will eat well, and allows customers to make purchasing decisions based on guaranteed eating quality. In contrast to the drive for quality beef that I observed in Australia and the USA, it appears that the British beef industry has lost sight of what is important – the production of high eating quality beef, at a price which gives customers good value for money. By maintaining the use of a grading system which is unrelated or potentially detrimental to eating quality, the British beef



industry is unable to make use of marketing strategies such as those used in Australia and the USA, where grading and branding is directly linked to quality. If the EUROP grading system is maintained long term, and breeding strategies continue to be targeted towards it, the British beef industry is in danger of driving down the quality of its own product, so reducing sales and potentially risking the long term viability of the whole industry.

A major factor in both the USA and Australia is a strong sense of integration amongst all members of the beef supply chain. Feedback from finishers to breeders is driving the breeding of high-quality cattle which can be finished efficiently, and producer-processor communication means that finished weights are targeted to the processor requirements, meaning variability is reduced and quality is consistent. The grading system in Australia was actually established from a significant customer survey on the factors that affect beef eating quality, and some retailers in the USA offer 'money back guarantees' on beef if the quality is unsatisfactory. Not only can integrated supply chains cut costs, but they also facilitate the sort of information sharing which can influence major factors within the industry, such as breeding decisions, finished carcase weights and grading. The UK beef industry is currently fragmented, with each member of the supply chain focused on their own sector, and little feedback of information or ideas across the different supply chain levels. By adopting a more integrated supply chain, the exchange of information could potentially drive the modification of the grading system, in response to customer feedback on quality; the reduction of finished weights in response to processor requirements; and the targeting of breeding strategies as a result of feedback on the efficiency of finishing performance.

If the EUROP grading system is maintained long term, and breeding strategies continue to be targeted towards it, the British beef industry is in danger of driving down the quality of its own product

Whilst the role of each supply chain member is distinct, the goal of the whole supply chain must be the same – the production of high eating quality beef at an affordable price. If the industry comes together to share information and work towards this common goal, quality and profitability should improve, benefiting all members of the supply chain.

The UK beef industry is a world leader in the regulation of traceability and welfare. Unlike the USA beef industry, where the use of growth hormones is permitted, the UK industry prohibits the use of such drugs. Coupled with the highest traceability and welfare standards, this provides a very strong platform for the promotion of British beef to the consumer. With improved quality and consistency, more could be done to market British beef as a high eating quality product, coupling the 'Red Tractor' brand with a newly established quality brand in a highly visible marketing campaign to promote British beef sales. By improving integration and renewing industry focus on the points described above, the UK is in an extremely positive position to establish a more robust and efficient industry; one not only known for excellent animal welfare and meat traceability, but also for the production of high eating quality beef. This structural refocus, if embraced by all levels of the beef supply chain, could in time help to re-establish the reputation of the UK amongst the world's best beef producers.



10. Conclusions and recommendations

With some of the best welfare and traceability regulations in the world, the UK beef industry has a strong basis from which to grow and improve. However, in order to do this I believe that there must be a fundamental focus shift throughout the beef supply chain, to the production of high quality beef, rather than high quality cattle. I would make the following recommendations to facilitate this focus shift:

- Introduce a new grading system, where grade and payment is based on beef eating quality, rather than carcass conformation. The grading system should also reward for tighter carcass specification to aid uniformity.
- Using the new, quality-based grading system, a new quality-related branding system should be developed and promoted, justifying pricing differences and allowing consumers to make purchasing decisions based on eating quality.
- Dispense with the current store period and move to finishing cattle at 12–14 months of age, meaning that cattle are feed-efficient from weaning, to reduce finishing costs and fulfil the current processor demands for smaller, lighter carcasses.
- Improve supply chain integration by the introduction of retained ownership for breeders and the establishment of contract cattle finishers, to allow finishing performance to influence breeding decisions.
- Focus beef cattle breeding programmes on profit-linked traits such as net feed efficiency and utilise composite terminal sires to drive hybrid vigour and improve heritability of such traits in the British beef herd.



11. After my Nuffield Farming Study Tour

Since my Nuffield Farming study tour I have been appointed to the position of Farm Manager at Myton Hall Farms, giving me more opportunities to modify our own business practices to improve efficiency and profitability. Some of the measures we have introduced or are in the process of introducing are:

- We are attempting to establish our own integrated supply chain, by finding private suppliers rather than sourcing cattle from auction marts. We hope that through the feedback of information on key performance indicators we can improve the quality and consistency of the cattle we purchase.
- We have started to purchase smaller cattle with the aim of reducing finished weights, to improve feed efficiency within our system and meet the demand from our processor for smaller carcasses.
- We have modified our finishing ration, replacing straw with hay to improve palatability and nutrient value, whilst reducing costs and maintaining fibre content.
- Although we do not breed cattle at Myton Hall Farms, we do run flock of commercial breeding ewes. We have purchased some Meatlinc composite terminal sires to increase hybrid vigour in our flock and have begun measuring and recording production traits. Our aim is to improve efficiency by reducing ewe size. We have done this by the introduction of a flock of Lleyn ewes, which are smaller than our previous Mule and Texel cross ewes, but which when bred to Meatlinc sires are capable of the efficient rearing of quality commercial lambs.



12. Executive Summary

The demand for British beef has reduced in recent years, likely due to challenging economic times and high beef retail price compared to other meat protein sources such as pork and poultry. Reduced demand for British beef has seen low fat prices, whilst store prices remain high, as the declining UK suckler herd limits the availability of store cattle. The current combination of high store prices, increased production costs, low fat prices and declining sales is not sustainable, and the British beef industry must look to improve efficiency within beef production systems to reduce production costs and maintain positive margins.

However, despite a global economic downturn, not all beef-producing countries are experiencing a drop in demand. The industries in Australia, the USA and Brazil are thriving, buoyed by strong export markets in response to an increasing demand for beef in East and Southeast Asia. Efficiency is a key concept in beef production for Australia and the USA, with management and breeding strategies being targeted towards increasing production efficiency. Whilst UK beef cattle are finished at high weights following an extended store period, the USA and Australian beef industries dispense with a store period, finishing lighter, younger cattle and utilising the period of maximal feed efficiency. Beef cattle breeding programmes are also aimed at producing animals with high rates of feed conversion, in an effort to achieve increased gain from the same input cost. Increased efficiency in beef production systems reduces production costs which mean on-shelf beef prices are lower, reducing the differential between beef and other meat protein sources and encouraging sales.

Improving quality is another key factor in maintaining beef sales in challenging economic periods. British beef producers are paid according to carcass grading on the EUROP Grid, a pay scale that rewards for carcass conformation, but not for eating quality, which is subsequently variable. The most effective way to guarantee quality is to use a grading system which rewards the production of high eating quality beef, incentivising producers to target their breeding and production protocols towards this aim. This system works well in both Australia and the USA, where grading is based on factors affecting eating quality, and is extended into product labelling and marketing, providing reassurance for customers on the quality of their purchases.

The UK beef industry is made up of many fragmented elements – producers focusing solely on their individual supply chain elements, with little communication between different members of the chain. Integration can be used to share information throughout the supply chain, ensuring that requirements are recognised and met. The industry must now move to respond to changing times. By improving integration and communication within the supply chain, targeting breeding and management strategies towards increased efficiencies and adopting a grading system rewarding the production of high eating quality beef, the UK beef industry is in a position to re-establish a robust market for British beef as a high quality affordable product, produced to some of the best welfare and traceability regulations in the world.

Richard Pennock



13. Acknowledgements

I would like to thank my primary sponsors the Yorkshire Agricultural Society and the Nuffield Farming Scholarships Trust for providing me with the opportunity to undertake a Nuffield Farming Scholarship. I must also acknowledge my secondary sponsors for their contributions towards my study tour: so thanks to:

D Palmer & J Dawson, NFU Mutual, Thirsk Branch
DB Agriculture & Agrinexus Ltd
DKB Crop Protection
Easingwold & Boroughbridge NFU
Gleadell Agriculture Ltd
Greens Farm Supplies
Impact Building Services
Oil NRG
Paul Row Agricultural Contractor
Penrith & District Farmers Mart
Peter Rhodes Feed Services
Rae, Bean & Partners Veterinary Surgeons
Russels Farm Machinery
Wm Morrisons PLC

I wish to thank all the people and organisations that I visited for taking the time to meet with me during my study tour. In particular, special thanks to the following for their generous hospitality:

Doyle Sanders
Gary Frenzel
The Noble Foundation
Steve and Penny Radakovich
Otavio Celidonio
Paulo Moraes Ozaki
Ross Houghton

I wish to thank Becky, my wife, for her continued support throughout this process, for the many hours she has spent helping to organise my visits and travel and for providing me with some of the most detailed travel itineraries ever seen on a Nuffield Farming study tour!

Lastly I must thank my employer, Sir K D Morrison, for his wholehearted support before, during and since my Nuffield Farming study tour, and for affording me the time to undertake such a valuable experience.



14. References

- (1) EBLEX UK Cattle Yearbook 2014
- (2) Retail prices for July 2015, Wm Morrisons
- (3) www.ahdb.org.uk/news/documents/ChrisDickinson-NFU.pdf
- (4) <http://pork.ahdb.org.uk/prices-stats/costings-herd-performance/finishing-35-110kg/> (Accessed 19/07/15)
- (5) YouGov Survey for Eating Better 2013
- (6) McMichael A J et al, 2007. Food, livestock production, energy, climate change and health. *The Lancet* 370: 1253 – 1263.
- (7) <http://www.theguardian.com/environment/2014/dec/03/eating-less-meat-curb-climate-change> (Accessed 13/06/15)
- (8) <http://www.worldmeatfreeday.com> (Accessed 21/06/15)
- (9) <http://www.thisismoney.co.uk/money/news/article-2282534/How-Morrisons-cut-middlemen-deliver-better-meat.html> (Accessed 20/06/15)
- (10) Myton Hall Farms store cattle and fat cattle purchase and sale prices January – July 2015.
- (11) Balancing the Market – Securing the Future for English Beef Supply. A Special Report. Published by EBLEX, May 2012.
- (12) http://www.meatinfo.co.uk/news/archivestory.php/aid/16338/Supply_chain_improvements_needed_for_British_beef_and_lamb_says_Morrisons.html (Accessed 18/06/15)
- (13) http://www.signetfbc.co.uk/wp-content/uploads/2014/11/factsheet1_estimated_breeding_values_for_beef_cattle1.pdf
- (14) http://www.signetfbc.co.uk/wp-content/uploads/2014/11/factsheet2_how_estimated_breeding_values_are_calculated_for_beef_cattle1.pdf
- (15) <http://www.isacattleco.com/Beefmasters/beefmaster.html> (Accessed 19/07/15)
- (16) <http://www.paringalivestock.com.au/wp-content/uploads/aboutstabilizerbreed.pdf>
- (17) <http://www.bigbeef.co.uk> (Accessed 13/07/15)
- (18) beefextension.com/proceedings/cattle_grains06/06-7.pdf
- (19) <http://growsafe.com> (Accessed 04/07/15)
- (20) <https://www.gov.uk/the-beef-carcase-classification-scheme-classify-carcases> (Accessed 06/06/15)
- (21) www.beefresearch.org/cmdocs/beefresearch/beefgrading.pdf
- (22) <http://www.ausmeat.com.au/media/1711/chille2010.pdf>
- (23) <http://www.australianbutchersguild.com.au/Meat-Standards-Australia> (Accessed 05/07/15)
- (24) Meat Standards AustraliaTM Standards Manual. Section 5: Livestock Supply. Version 2, 20th March 2015. ISBN 9 781925045178.



15. Appendix 1

List of visits

Australia

Contact name	Organisation	Location
Don Mackay	Rangers Valley Feed Lot	Glen Innes, NSW
Hugh Banks	ACC Cannon Hill	Brisbane, Qld
Jim Titmarsh	ACC Feedlot	Roma, Qld
Peter Parnell	Angus Australia Feed Lot	Armidale, NSW
Dr. Robert Banks/Dr. Alex Ball	University Of New England	Armidale, NSW
Dr. David Pethick	Murdoch University, School of Veterinary and Biomedical Sciences	Murdoch, Western Australia

USA

Contact name	Organisation	Location
Dr. Dustin T. Dean	Sexing Technologies	Navasota, Texas
Gordon Carstens/ David Greg Riley/ Dr. Penny K. Riggs	Texas A & M University, Dept. of Animal Science	College station, Texas
Doyle Sanders	DBL D Bar Ranch Beefmasters	Industry, Texas
Gary Frenzel	Frenzel Beefmasters	Temple, Texas
Mackie Bounds	Swinging 'B' Ranch	Axtell, Texas
Mary Means	Noble Foundation	Ardmore, Oklahoma
Dr. Clint Rusk	Oklahoma State University, Department of Animal Science	Stillwater, Oklahoma
BIF Conference		Lincoln, Nebraska
Janel Nierman	US Meat Animal Research Centre	Clay Centre, Nebraska
Steve and Penny Radakovich	RCC	Earlham, Iowa
David Nichols	Nichols Farms	Bridgewater, Iowa
Jerry Wulf	Wulf Cattle	Atkinson, Nebraska
Dan Dorn	Decatur County Feed Yard	Oberlin, Kansas
Meghan Blythe	JBS Five Rivers Feedlot	Kuner, Colorado
JBS	JBS Kill Plant	Greeley, Colorado
Steve Gabel	Magnum Feeders	Wiggins, Colorado
Ryan Peterson	Leachman Cattle of Colorado	Wellington, Colorado
Dr. Jason K. Ahola	Colorado State University, Dept. of Animal Sciences	Fort Collins, Colorado



Canada

Contact name	Organisation	Location
John Basarab	Lacomb Research Centre	Lacomb, Alberta
Calvin Booker	Feedlot Health	Okotoks, Alberta
	International Livestock Congress	Calgary, Alberta
Alison Sunstrum/ Camiel Huisma	GrowSafe	Airdrie, Alberta

Brazil

Contact name	Organisation	Location
Fernando Sampaio	ABIEC (Association of Brazilian Beef Exporters)	Sao Paulo
Fernando Saltao/ Joao Bastos	JBS	Sao Paulo
Gabriela Garcia Ribeiro/ Flavia Gutierrez/ Dr. Thiago Bernadino de Carvalho/ Dr. Sergio De Zen	CEPEA (Centre for Advanced Studies on Applied Economics)	Piracicaba
Murillo Meschiati	Esalq's Feedlot	Piracicaba
Klever Coral	Coplacana Feedlot	Piracicaba
Carlos Augusta Zanata/ Rafael Linhares	FAMATO	Cuiaba
Otavio Celidonio/ Paulo Moraes Ozaki	IMEA (Mato Grosso Institute of Agricultural Economics)	Cuiaba
	ACRIMAT (Breeders Association of Mato Grosso)	Cuiaba
Primo Menegalli	Feedlot	Campinas
Felipe de David Bortolotto	Cargill	Campinas
Luiz Carlos Meister	Cow/calf ranch	Cuiaba
Olimpio Riso de Brito	Cow/calf ranch	Mato Grosso
Camargo Correa	Cow/calf ranch	Mato Grosso

Uruguay

Contact name	Organisation	Location
Ross Houghton	Angus Los Principios	Flores, Uruguay
	BPU (Breeders and Packers Uruguay)	Durazno, Uruguay
Fermin Peixoto	Il Tramonto Feedlot	Soriano, Uruguay